IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:
Somenath Mitra et al.

Application No.: 10/735,989

Filed: December 15, 2003

For: Micromachined Heaters For Microfluidic Devices

Confirmation No.: 4147

Group Art Unit: 3742

Examiner: Daniel Leon Robinson

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

BRIEF ON APPEAL

Sir:

Further to the Notice of Appeal filed on March 5, 2010 for the subject application, this brief in support of the appeal is hereby submitted. This brief is being timely filed. A petition for 1 month extension is included herewith.

1. Real Party in Interest

The real party in interest is New Jersey Institute of Technology, assignee of the application from the inventors/appellants.

2. Related Appeals and Interferences

There are no appeals or interferences that are related to this appeal, or which will affect or have a bearing on this appeal.

3. Status of the Claims

Claims 1-9 were finally rejected in an Office Action mailed on October 9, 2009, and are the subject of this appeal. Claims 10-20 were previously withdrawn.

4. Status of Amendments

No amendment was filed after final rejection.

5. Summary of Claimed Subject Matter

Independent claim 1 recites a microheater for microfluidic devices comprising at least one microchannel having a length formed on a substrate and further comprising at least one conductor disposed in said microchannel along a majority of the length of said microchannel. Claim 1 requires the presence or formation of a microheater or microheater device in a microchannel along a majority of a length of the microchannel.

The subject matter of claim 1 is specifically found in and supported by the specification at, for example, page 5, lines 1-9, 14-16; page 7, line 1 to page 9, line 22; page 10, line 6 to page 13, line 10 and FIGs. 1A-1E and 2A-2E.

The dependent claims are directed to various embodiments of the disclosed apparatus. The dependent claims include further detail relating to: the nature of and/or composition of the conductor element (claims 2-4); the nature of and/or the composition of the substrate element (claim 5-8); a glass layer disposed on the conductor element (claim 9).

The subject matter of the dependent claims is further specifically found in and supported by the specification at, for example, as follows:

Claim 2: page 9, lines 13-19 and FIG. 2D.

Claim 3: page 9, lines 20-21.

Claim 4: page 8, lines 17-19 and FIG. 1D.

Claim 5: page 7, line 7, FIGs. 1A-1E and 2A-2E.

Claim 6: page 7, lines 8-13.

Claim 7: page 7, lines 8-10.

Claim 8: page 7, lines 19-20.

Claim 9: page 7, lines 17-19; page 8, line 20 – page 9 line 11, FIGs 1E and 2E.

A copy of the appealed claims is appended hereto, beginning at page 14.

6. Grounds of Rejection to be Reviewed on Appeal

a. Whether claims 1-2 and 5 are anticipated under 35 U.S.C. §102(b) by Lin et al. (U.S. Pat. No. 5,591,139, "Lin").

b. Whether claims 6-7 and 9 are unpatentable under 35 U.S.C. §103(a) as being obvious over the '139 patent in view of Ferguson (2003/0209534, "Ferguson").

c. Whether claim 3 is unpatentable under 35 U.S.C. §103(a) as being obvious over Lin in view of Kenny (6,551,849, "Kenny").

d. Whether claims 4 and 8 are unpatentable under 35 U.S.C. §103(a) as being obvious over Lin in view of Yamazaki et al. (6,165,876, "Yamazaki") and further in view of Ueno et al. (2002/00224662, "Ueno").

7. Argument

a. Rejection Under 35 U.S.C. §102(b)

i. Claims 1-2 and 5

Claims 1-2 and 5 stand finally rejected under 35 U.S.C. §102(b) as allegedly anticipated by Lin. No reasons for the rejection were stated in the Final Office Action, but it is assumed the basis is the same as that stated in the March 30, 2009 rejection, discussed below. Appellants submit the Lin reference does not disclose or suggest each and every limitation of claim 1.

Claim 1 recites a microheater for microfluidic devices comprising at least one microchannel having a length formed on a substrate and further comprising at least one conductor disposed in said microchannel along a majority of the length of said microchannel. Claim 1 requires the presence or formation of a microheater or microheater device in a microchannel along a majority of a length of the microchannel.

The Lin reference neither discloses nor suggests a microchannel having disposed therein a microheater or microheater device that is disposed along a majority of a length of a microchannel. The only microheater in the Lin reference is formed from a plurality of individual resistors 60 perpendicular to the microchannel and is located only in microflow channel 78 at the interface region 11 of the microneedle 10 (*see* col. 3, lines 36-38 and FIG. 2A of the Lin patent). There is no microheater or means to achieve microheating located in the remaining majority portion of the microflow channel 78. In contrast, claim 1 requires a microheater that extends through at least a majority of the microchannel. As a result, the Lin patent does not contain each and every limitation of claim 1.

On page 5 of the March 30, 2009 Office Action the Examiner pointed to the following portion of the Lin patent as the basis for rejection:

> Heating resistors 60 may be used to form a thermally-driven, cascaded-bubble micropump or simple heater. The microneedle may also include detector resistors 62 which extend along the bottom of the microchannel (see FIG. 1B) and are coupled to electrodes 84 (FIG. 3L-2) on the tip 86 of the needle. Microflow channel 78 is formed by removing

> sacrificial layers from underneath a shell 26 during processing. In order to access the sacrificial layer, etch access holes 74 are opened and then filled after etching. The fabrication procedures will be discussed below in relation to FIGS. 3A-1 through 3N-2.

This cited portion of the Lin patent does not disclose or suggest at least one conductor disposed in the microchannel along a majority of the length of the microchannel as required in appellants' claim 1. The heating resistors 60 and detector resistors 62 of the Lin patent are completely different and are not related to one another in any way. As further disclosed in the Lin patent, the "detector resistors 62 extend lengthwise along shaft 14 and function as wires to relay a signal from electrodes or recording sites 84 (FIG. 2A) to the shank end of the channel, where electronics 24 process the signals" (Lin, col. 5, lines 19-22). As disclosed, the detector resistors 62 that extend along the shaft 14 have absolutely nothing to do with, and are not capable of, heating. Clearly, the Lin patent does not disclose any resistor along shaft 14 that could be construed as a heating resistor.

Moreover, there is no disclosure in the Lin patent of where the referenced micropump could be incorporated onto the microneedle of Lin, and no disclosure at all of disposing such a pump in a microchannel. The Lin patent teaches that the portion of the microchannel that is not in the interface region of Lin is reserved for the detector resistors, and should not have heating resistors. The Lin reference further discloses, in a preferred embodiment (FIG. 2A):

> A single resistor is shown in FIGS. 4A and 4B to illustrate its positioning [i.e., in the interface region]. However, in a preferred embodiment five resistors 60 form a thermally-driven cascaded bubble pump (FIG. 2A). In operation, the resistor furthest from the needle tip is heated and produces a single vapor bubble. Then, the adjacent resistor is heated and the bubble is moved sequentially down the line of resistors toward the distal end of the needle shaft. The resistors are heated quickly and sequentially, so that precise fluid control is possible. If a cascaded bubble pump is not employed, a fluid may move down the needle shaft simply by means of gravity.

Lin patent, col. 8, lines 15-23.

This portion of the Lin patent stresses that the heating resistors 60, regardless of their number (single or multiple) or form (single heater, or serially-arranged for a bubble pump), are located only in the interface region 11 of the microneedle and not anywhere else. This is consistent with the entire thrust of the Lin patent, which teaches that there should not be any microheater, let alone the specifically claimed conductor, or any other means to achieve microheating, located in the remaining majority portion of the microflow channel. The remainder of the microflow channel not including the interface region is specifically reserved for detector resistors 62, which are not heating resistors or conductors. See, Lin col. 3, lines 33-43 and 63-66. In contrast, appellants' claim 1 includes a conductor that is disposed in and extends along a majority of the microchannel.

In addition, in the Lin patent the size of the heating resistors 60 (50 μm long x 2 μm wide - see col. 5, lines 18 and 29) relative to the interface region 11 (1.5 mm – dimension X in FIG. 2A) and the overall length of the microneedle device (2.5-8.5, dimension X plus dimension Y in FIG. 2A) is so small that there is no teaching or suggestion of the heating resistor(s) being present in anything even remotely close to the claimed "majority of the length" of the microchannel.

Since all the heating resistors of the Lin patent must be in the interface region, and all the heating resistors are small, any further micropumps or microvalves referred to in Lin must also be located in the interface region and be small, and regardless of their number, cannot form at least one conductor disposed in the microchannel along a majority of the length of the microchannel as in claim 1. As a result, the Lin reference does not contain each and every limitation of claim 1 and cannot anticipate claim 1. Claims 2 and 5 depend from claim 1 and recite additional features and are likewise allowable. Accordingly, appellants respectfully request this rejection be withdrawn.

In light of the above discussion, appellants submit the Lin patent does not contain each and every limitation of claim 1. Claims 2 and 5 which depend from claim 1 and recite additional features are also not anticipated and therefore allowable. Accordingly, the appellants respectfully submit the rejection of these claims should not be sustained and the claims be allowed.

b. Rejections Under 35 U.S.C. § 103(a)

i. Claims 6-7 and 9

Claims 6-7 and 9 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Ferguson. Appellants respectfully disagree.

According to MPEP § 706.02(j):

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Claim 1, from which claims 6, 7 and 9 depend, has been recited and discussed at length hereinabove. Claim 6 recites a quartz substrate and claim 7 recites a borosilicate substrate. Claim 9 recites a glass layer on the conductor. Appellants submit that neither the Lin patent nor the Ferguson reference, alone or in combination, teach or suggest the subject matter of claims 6-7 and/or 9.

The shortcomings of the Lin patent have been set forth in detail above. The Lin patent relates to a micromachined needle having an interface region 11 and elongated shaft portion 14 and enclosed microchannel 78 disposed along the length of the interface region 11 and shaft portion 14. The enclosed microchannel 78 includes a microheater 60 only in the interface region 11 and specifically does not include any heating device in the shaft region. See, *e.g.*, FIG 1A of Lin.

Ferguson relates only to quartz and borosilicate substrates. Nothing in the Ferguson reference even remotely suggests at least one conductor disposed in a microchannel along a majority of the length of a microchannel as in claim 1.

Accordingly, Ferguson does not remedy the deficiency of the Lin patent. The combination of the teachings of the Lin patent and Ferguson results in a microheater disposed only in an interface region of a microneedle having a substrate comprising quartz and borosilicate glass. That combination is not the subject matter of claim 1, let alone dependent claims 6, 7 and/or 9.

Based on the foregoing, the Appellants submit claims 6, 7 and 9, which depend from claim 1 and recite additional features, are not obvious in view of the cited references. Accordingly, the appellants respectfully submit the rejection of these claims should not be sustained and the claims be allowed.

ii. Claim 3

Claim 3 stands finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Kenny. Claim 3 depends from claim 1 and recites further features, *i.e.*, the conductor comprises an aluminum alloy comprising 99% aluminum and silicon and copper. The shortcomings of the Lin patent with respect to claim 1 have been detailed hereinabove. Kenny discloses only a method of fabricating arrays of microneedles which may be electrically conductive wherein cavities in the substrate bulk may be filled with an electrically conductive material such as gold, tungsten, copper, nickel, aluminum or doped polysilicon. Kenny cannot cure the shortcomings of Lin, as it contains no disclosure of a microfluidic device comprising at least one microchannel having a length formed on a substrate and further comprising at least one conductor disposed in said microchannel along a majority of the length of said microchannel. Moreover, Kenny does not disclose the alloy of claim 3. Since the Lin patent does not teach or suggest the invention of claim 1, and Kenny does not disclose the limitations of claim 3, the combination of references cannot result in the invention of claim 3. Accordingly, the Appellants respectfully submit the rejection of claim 3 should not be sustained and the claim be allowed.

iii. Claims 4 and 8

Claims 4 and 8 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Yamazaki et al. and further in view of Ueno et al.

Claims 4 and 8 depend from claim 1 and recite additional features. Claim 4 recites the conductor comprises implanted boron ions. Claim 8 recites the substrate comprises an oriented, boron doped, single side polished silicon wafer. As set forth in detail hereinabove, the Lin patent does not disclose the subject matter of claim 1. Yamazaki merely discloses a method of doping silicon film with boron ions. The Ueno reference discloses only a microfluidic cell having a mirror-polished Pyrex substrate and microchannels, and a silicon nitride film deposited on one surface of the substrate. Hence, the teachings of Yamazaki, alone or in combination with Ueno, cannot cure the deficiencies of the Lin patent to achieve the subject matter of claims 4 and/or 8. The combination of the Lin patent, Yamazaki and Ueno at best result in a microneedle device having a mirror-polished Pyrex substrate having an enclosed microchannel with a boron ion-implanted microheater only in the interface region and specifically does not include any heating device in the shaft region. This is not the subject matter of claims 4 and/or 8. Accordingly, the Appellants respectfully submit the rejection of claims 4 and 8 should not be sustained and the claims be allowed.

CONCLUSION

Appellants submit that claims 1-9 meet the requirements for patentability under §§102 and 103. Accordingly, reversal of the Examiner's rejections is appropriate and is respectfully solicited. The fee for a one-month extension of time is submitted herewith.

Dated: May 18, 2010

Respectfully submitted,

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CLAIMS APPENDIX

1. A microheater for microfluidic devices comprising at least one microchannel having a length formed on a substrate and further comprising at least one conductor disposed in said microchannel along a majority of the length of said microchannel.

2. A microheater according to claim 1 said conductor selected from the group consisting of metal, metal alloys, composites of organic conducting polymers and metals and organic conducting polymers; and implanted ions.

3. A microheater according to claim 2 said conductor comprising an aluminum alloy comprising 99% aluminum and silicon and copper.

4. A microheater according to claim 2 said conductor comprising implanted boron ions.

5. A microheater according to claim 1 said substrate comprising a wafer.

6. A microheater according to claim 1 said substrate comprising quartz.

7. A microheater according to claim 1 said substrate comprising borosilicate glass.

8. A microheater according to claim 1 said substrate comprising an oriented, boron doped, single side polished silicon wafer.

9. A microheater according to claim 1 further comprising a glass layer disposed on said conductor.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.